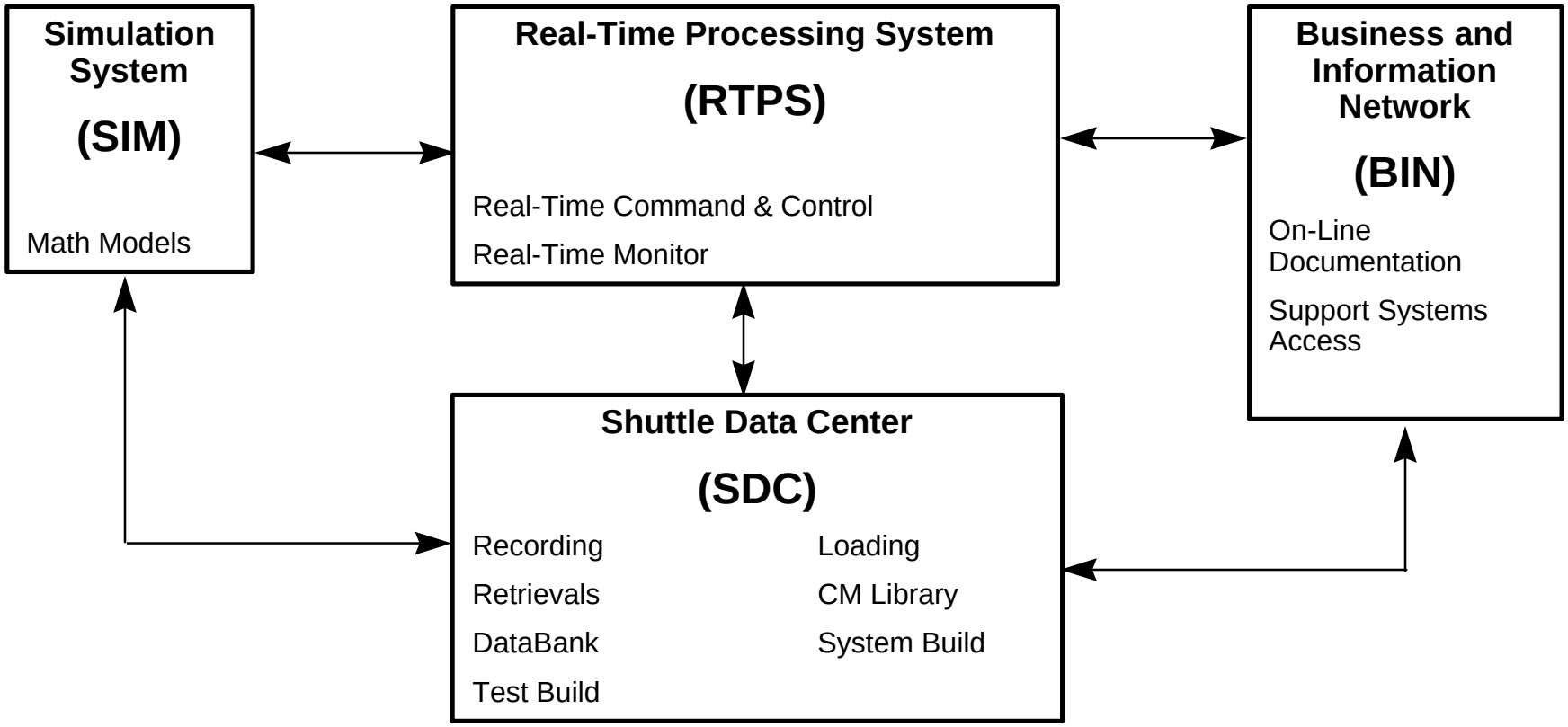
# CLCS
# System Architecture
# Overview

# CLCS Systems



# CLCS Systems (cont.)

- **CLCS consists of the following:**
  - **Real-Time Processing System (RTPS)**
  - **Shuttle Data Center (SDC)**
  - **Simulation System (SIM)**
  - **Business and Information Network (BIN)**

# CLCS Systems (cont.)

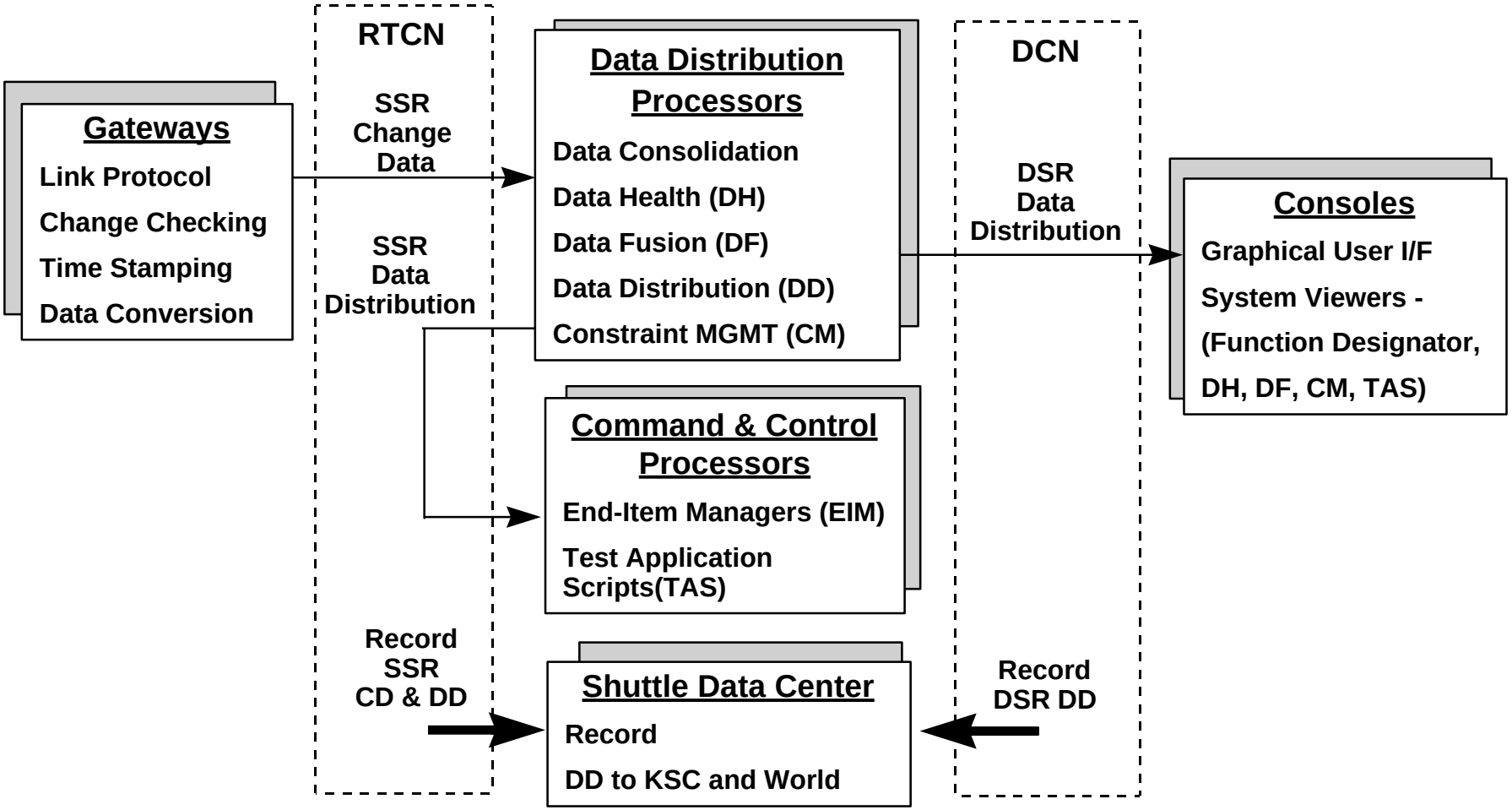
- **Real-Time Processing System -**
  - **Real-Time Command, Control and Monitoring of Space Vehicle and Ground Support Systems**
  - **Replaces the Launch Processing System (LPS) Checkout, Control and Monitoring Subsystem (CCMS)**
- **Business & Information Network**
  - **On-Line Documentation**
  - **Access to Support Systems**

# CLCS Systems (cont.)

- **Shuttle Data Center -**
  - **Recording and Retrieval of RTPS Data, Commands and Network Packets**
  - **Vehicle and Ground Systems Databases**
  - **Test Builds**
  - **System Builds**
  - **Test Set Loading**
  - **Configuration Management Library**
- **Simulation System**
  - **End-Item Math Models for System and Application Development and Validation**
  - **Test Team Training**

# Real-Time Processing System (RTPS)

# RTPS System-Level Block Diagram - Data




SSR = System Synchronous Rate (10 msec baseline), DSR = Display Synchronous Rate (100 msec baseline)

# RTPS DATA FLOW

- **Gateways**
  - **Acquire Data From Vehicle and Ground Systems**
  - **Change Check Measurement Values**
  - **Calibrate Change Data Into Engineering Units**
  - **Packetize and Deliver Change Data**
    - » **To the Data Distribution Processor (DDP) Via the Real-Time Critical Network (RTCN)**
    - » **At the System Synchronous Rate (10 Millisecond Baseline)**

# RTPS DATA FLOW (cont.)

- **Data Distribution Processor**
  - **Consolidate Change Data Received From Multiple Gateways**
  - **Append Health Information**
  - **Generate Fused Information (Calculated Values)**
  - **Monitor Measurements for Constraint Violations**
  - **Packetize and Deliver Consolidated Change Data and Fused Data With Health for Data Distribution**
    - » **System Synchronous Rate Data Distribution Via the Real-Time Critical Network (RTCN) to Multiple Command and Control Processors for User Control Applications**
    - » **Display Synchronous Rate (100 Milliseconds) Data Distribution Via the Display and Control Network (DCN) to Multiple Consoles for Display Applications**

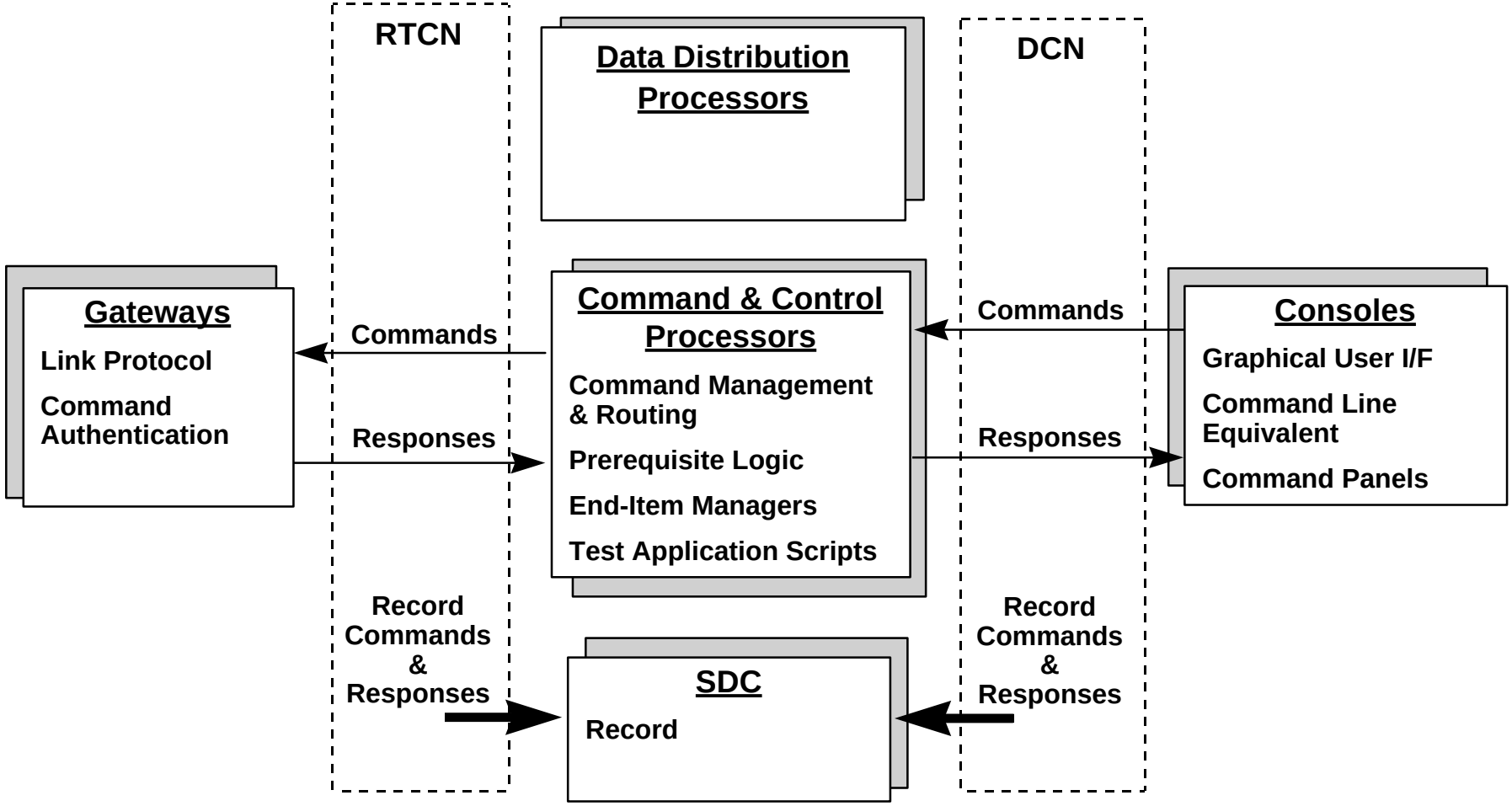
# RTPS DATA FLOW (cont.)

- **Command and Control Processors (CCP)**
  - **Deliver Data to User Control Applications**
    - » **Current Value Table**
    - » **All Changes of Selected Measurements Queued to Requesting Applications**
  - **Execute User Control Applications**
    - » **End-Item Managers**
    - » **Test Application Scripts**
    - » **Reactive Sequences**

# RTPS DATA FLOW (cont.)

- **Consoles**
  - **Deliver Data to Display Applications**
    - » **User and System Displays**
    - » **Current Value Table**
    - » **All Changes of Selective Measurements Queued to Requesting Applications**
  - **Execute Display Applications**
    - » **Graphical User Interface**
    - » **System Viewers**

# RTPS System-Level Block Diagram - COMMANDS




SSR = System Synchronous Rate (10 msec baseline), DSR = Display Synchronous Rate (100 msec baseline)

# RTPS COMMAND FLOW

- **User Initiated End-Item Commands**
  - **Initiated on the Console**
  - **Routed to the Appropriate CCP Via the DCN**
  - **Validated, Prerequisite Logic Checked and Routed to the Appropriate Gateway Via the RTCN**
  - **Authenticated and Delivered to the End-Item by the Gateway**
  - **Response Delivered to the CCP From the Gateway Via the RTCN**
  - **Response Delivered to the Console Via the DCN**

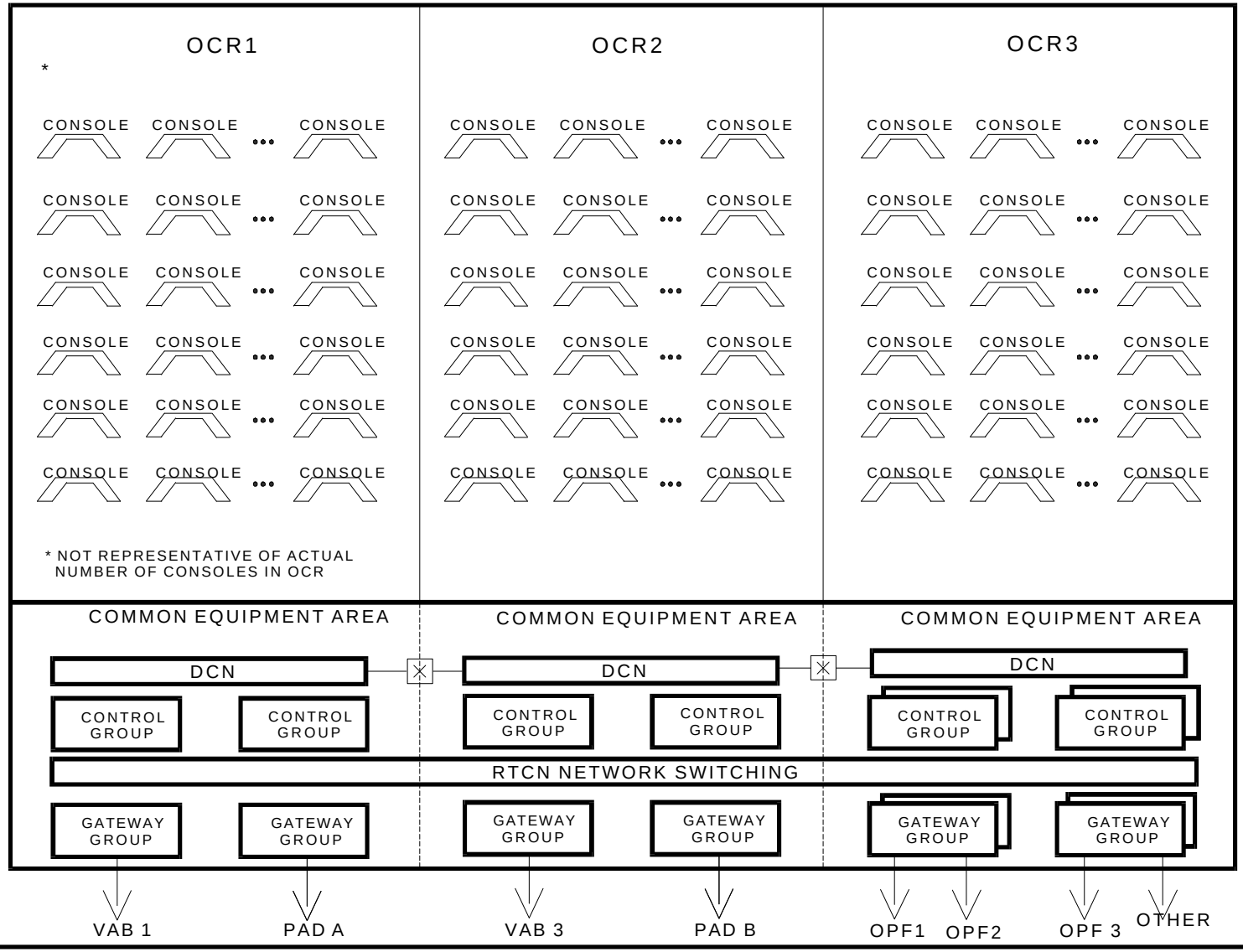
# RTPS COMMAND FLOW (cont.)

- **User Initiated Application Commands**
  - **Initiated on the Console**
  - **Routed to the Appropriate CCP Via the DCN**
  - **Validated and Routed to the Appropriate Application**
  - **Application Response Delivered to the Console Via the DCN**

# RTPS COMMAND FLOW (cont.)

- **Application Initiated Commands**
  - **Initiated in the CCP**
  - **End-Item Commands -**
    - » **Validated, Prerequisite Logic Checked and Routed to the Appropriate Gateway Via the RTCN**
    - » **Authenticated and Delivered to the End-Item by the Gateway**
    - » **Response Delivered to the CCP From the Gateway Via the RTCN**
    - » **Response Delivered to the Initiating Application**
  - **Other Application Commands**
    - » **Validated and Routed to the Appropriate Application**
      - **Remote CCP Via the RTCN**
    - » **Response Delivered to the Initiating Application**

# LAUNCH CONTROL CENTER SET



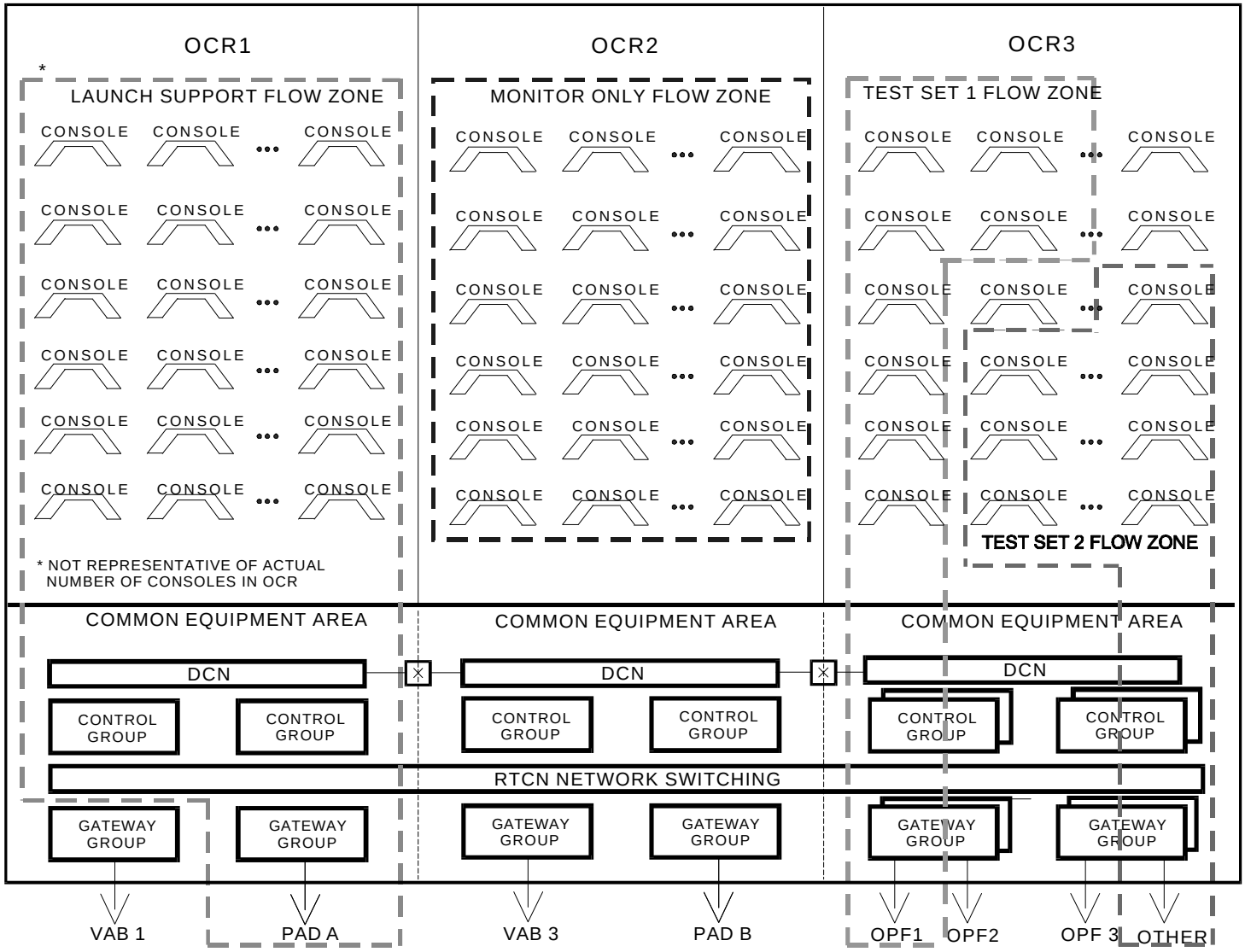
# LAUNCH CONTROL CENTER SET (cont.)

- **Primary Processing Utilizes the Real-Time Processing System LCC Set**
- **The LCC Set Is Re-Configurable to Support Several Parallel Activities**
  - **End-Item Tests**
  - **Software Validation/Development**
  - **User Training**

# LAUNCH CONTROL CENTER SET (cont.)

- **LCC Set Consists of -**
  - **Several Gateway Groups Consisting of the Gateways Required for Each End-Item Test Area (Pads, VABs, OPFs)**
  - **Several Control Groups Consisting of DDPs and CCPs**
  - **Many Consoles Which Can Be Configured Into Several Parallel Flow Zones**
- **Gateway Groups, Control Groups and Flow Zones Are Configured As Required Into Test Sets for -**
  - **End-Item Tests**
  - **User Training**
  - **Software Validation and Development**

# LCC SET - LAUNCH DAY EXAMPLE



# LCC SET - LAUNCH DAY EXAMPLE (cont.)

- **Consoles in Operations Control Room (i.e. OCR1) Configured As a Flow Zone**
- **OCR1 Flow Zone, Two Control Groups and a Pad Gateway Group Configured As a Launch Test Set**
- **Consoles in OCR2 Configured As a Monitor-Only Flow Zone**
- **Remaining Control Group and Gateway Groups Are Configured With Consoles in OCR3 to Support Other Operations**

# CLCS TEST SET- LAUNCH DAY EXAMPLE

- **My Test Set Chart**

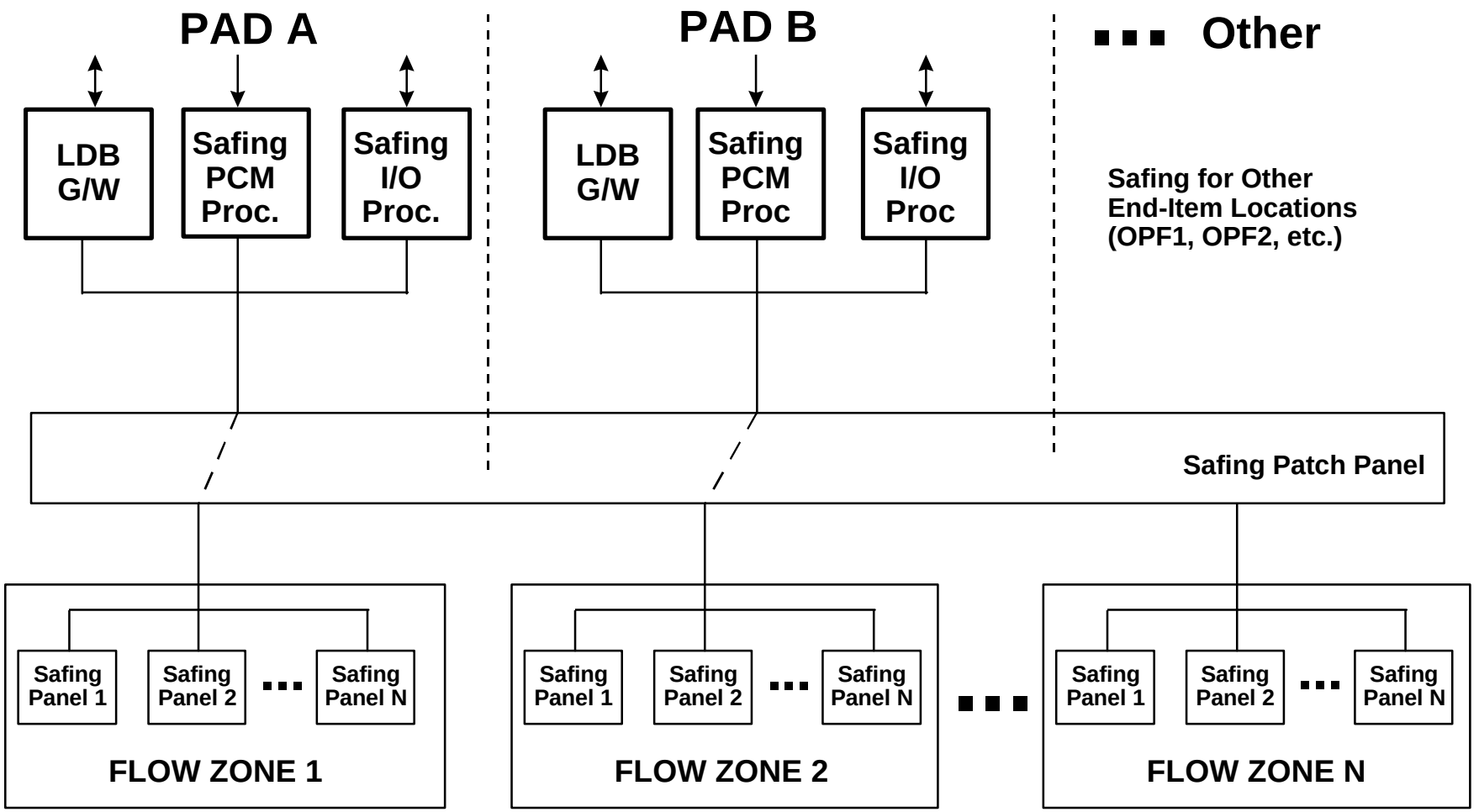
# CLCS TEST SET- LAUNCH DAY EXAMPLE (cont.)

- **Typical Launch Configuration**
  - **Pad Gateway Group**
    - » **Several Active and Standby Gateways**
    - » **Dual Real-Time Critical Network ATM Switches**
  - **Real-Time Critical Network Patching**
  - **Two Control Groups**
    - » **Eight Active and Eight Standby Command and Control Processors**
    - » **One Active, One Standby and One Hot Spare Data Distribution Processors**
    - » **Dual Real-Time Critical Network ATM Switches**

# CLCS TEST SET- LAUNCH DAY EXAMPLE (cont.)

- **Typical Launch Configuration (cont.)**
  - **Flow Zone**
    - » **Dual Display and Control Networks Attached to Alternating Consoles**
    - » **All Consoles in the Operations Control Room**
  - **Control Room**
    - » **Dual Restricted Operational Networks for Shared Peripherals and Business & Information Network Access for Alternating Consoles**
  - **SDC**
    - » **Active and Standby Recording Subsystems**
    - » **Active and Spare Load Servers**
    - » **Active and Spare Documentation and External System Servers**

# CLCS Safing Concept

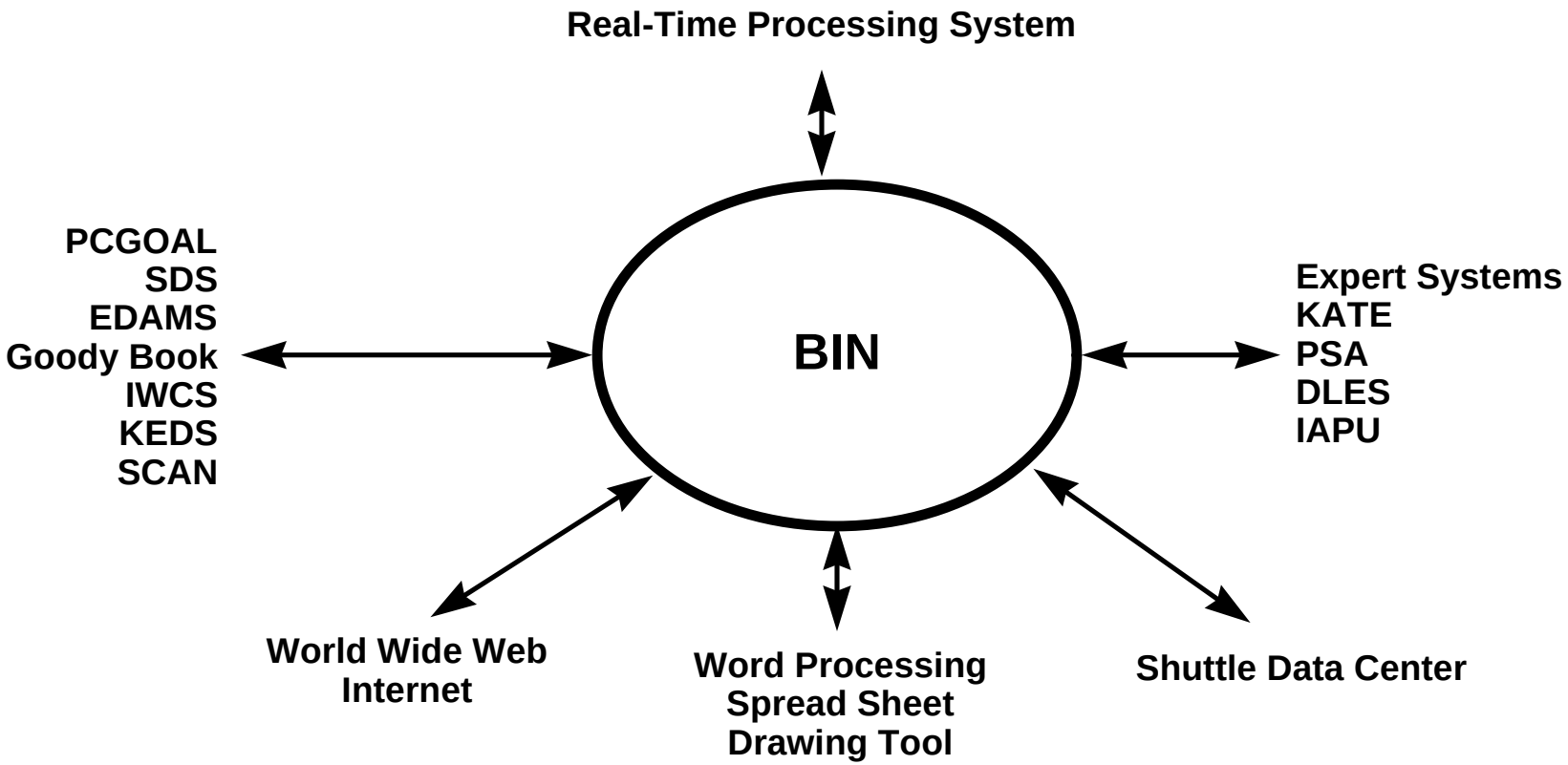


# CLCS SAFING CONCEPT

- **Isolated System for Safing Vehicle and Ground Systems in Case of a RTPS Failure**
- **Re-Configurable System to Support Safing in All LCC Areas From Any Command and Control Console in LCC Set**
- **Safing Panels at Each Command and Control Console**
- **Location Specific Front-End Subsystems**
  - **RTPS LDB Gateways for Vehicle Safing**
  - **PCM Processor for Vehicle Safing and Biomed Display Data**
  - **I/O Processor to Interface to Existing Hardwire Safing System**

# Business & Information Network

# Business Information Network

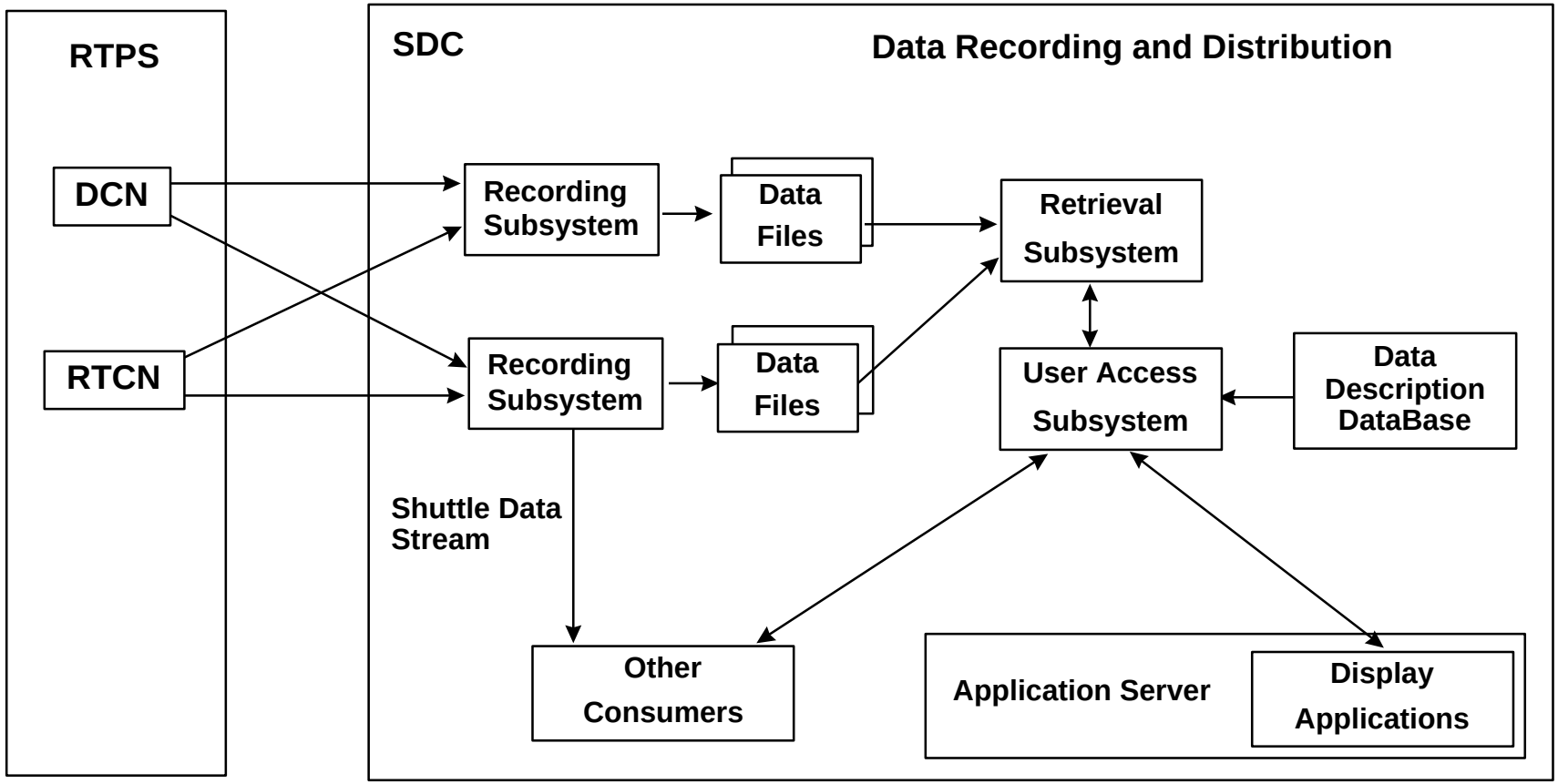


# Business & Information Network

- Access to Documentation
  - Drawing
  - Procedures, OMI's
  - Books
- Access to Mail
- Access to Office Tools
- Access to Retrieval Data
- Access to Other Flows and Other Centers Real-time Data
- Integration of PRACA
- Access for Advisory Systems

# SHUTTLE DATA CENTER

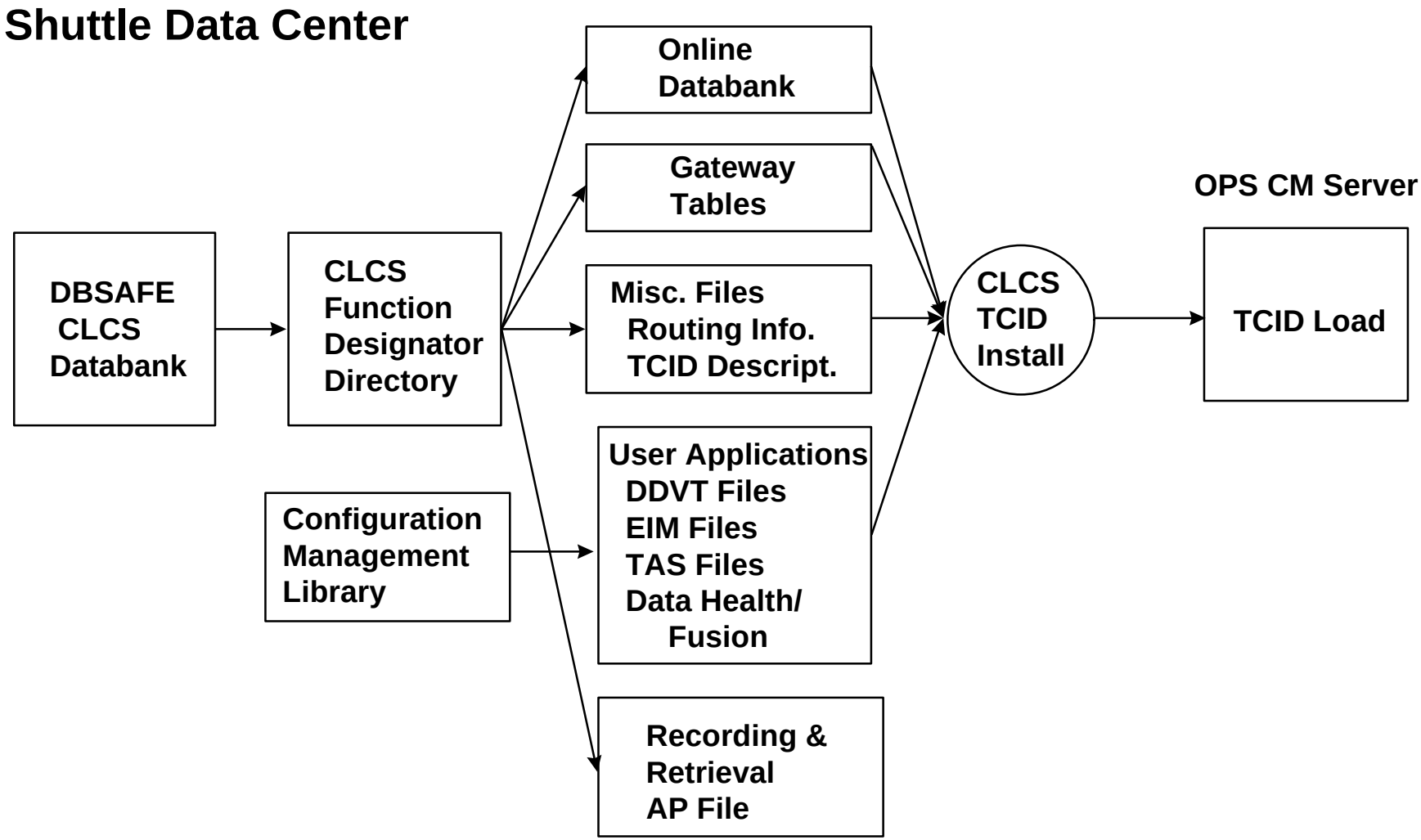
# Data Recording and Retrieval



# Data Recording and Retrieval

- Records All Test-Related Packets on All RTPS Networks
- All Packets Are Time-Stamped With GMT
- Maintains Complete Redundancy to the Recording Media
- Off-Line Data Can Be Restored Automatically From Tape
- Two Types of Recording
  - Packet Level for Troubleshooting (CCMS PDR Replacement)
    - » Packet-Level Data Maintained Online for 90 Days
  - Measurement and Message Data for Engineering (CDS TDRR Replacement)
    - » A Minimum of 4 Flows Processing for Each Orbiter Will Be Available Online for Measurement and Message Data
- Real-Time Shuttle Data Streams Are Distributed for All Test Sets

# CLCS Test Build Flow



# CLCS Test Build Flow

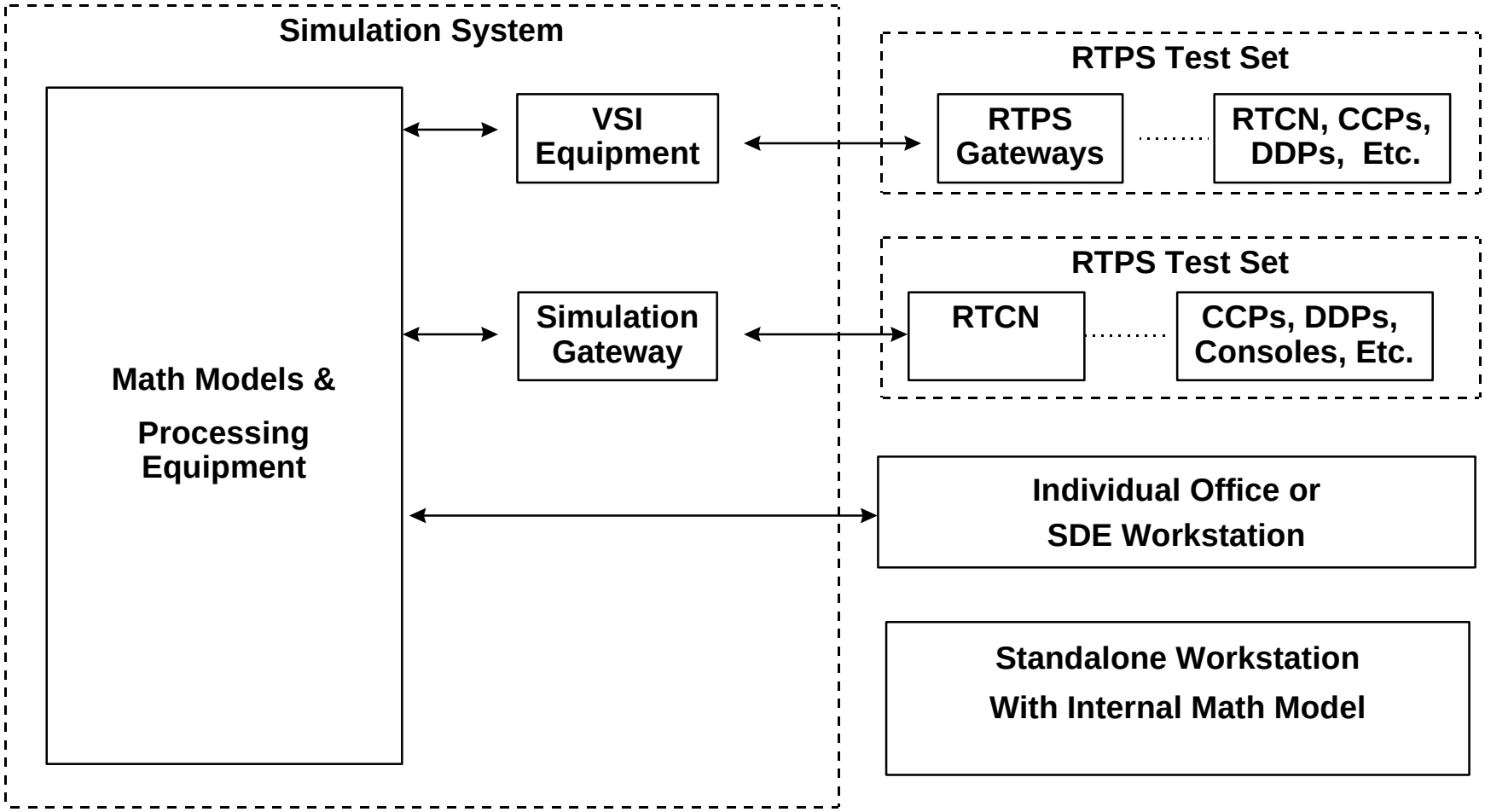
- **DBSAFE CLCS Databank**
  - **Oracle Database on SDC**
  - **Contains All Information on the Function Designators (Measurements, Commands, and System Parameters) Required for the Operation of CLCS Software from Shuttle Data Tape and User Input**
- **CLCS Function Designator Directory**
  - **Subset of FDs From the DBSAFE Databank Required to Support a Specific Test**
- **Online Databank**
  - **Information Required by RTPS Software for Processing FD Information (FD Type, FDID, Responsible System, Etc)**
- **Gateway Tables**
  - **Define Information Required by the Gateways to Process Data Coming From/Going to End Items**

# CLCS Test Build Flow

- **Miscellaneous Files**
  - **Defines Additional Information Required by the RTPS Set Such As Routing Information, TCID Description, System Software Build Which Are Compatible With This TCID, Etc.**
- **User Application Files**
  - **Dynamic Display Visualization Tool (DDVT) Files, EIM, TAS, Data Health and Data Fusion Algorithms Needed to Perform a Test Are Located in the CM Repository and Loaded As Part of the TCID**
- **Recording and Retrieval AP File**
  - **Information Used by the Retrieval System to Be Able to Decode FDID to FD Name for Formatting of Retrievals**
- **CLCS TCID Install and OPS CM**
  - **Provides Method of Loading the TCID Information From SDC to the Target RTPS Set**

# SIMULATION SYSTEM

# CLCS SIMULATION



# CLCS SIMULATION CONFIGURATIONS

- **Four Simulation Configurations Are Supported**
  - **Full-up Test-Set With VSI Subsystems Connected to Gateways**
  - **Limited Test-Set With Simulation Gateway(S) Connected to the Real-Time Critical Network**
  - **Minimal Configuration With a Simulation Host Connected Via Networks to a Workstation in an Office or Satellite Development Environment Set**
  - **Minimal Configuration in an Individual Workstation With Local Math Model(S)**